State of Tennessee Regional Water Supply Planning Pilot Study

TDEC
Water Resources Technical Advisory Committee
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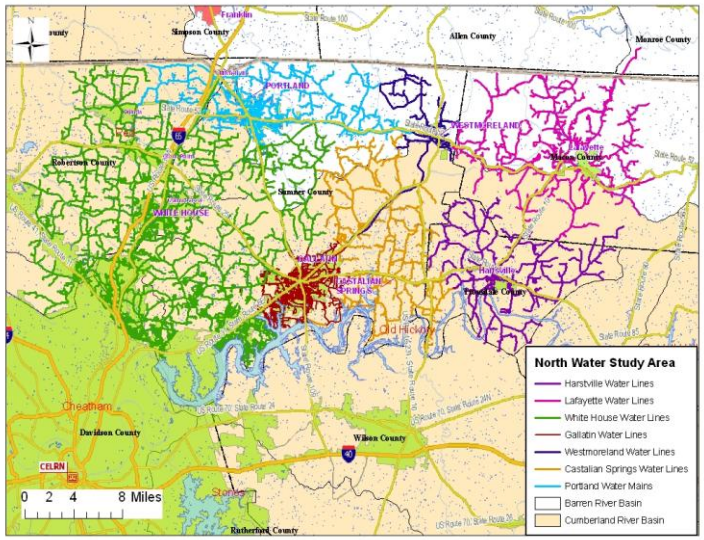
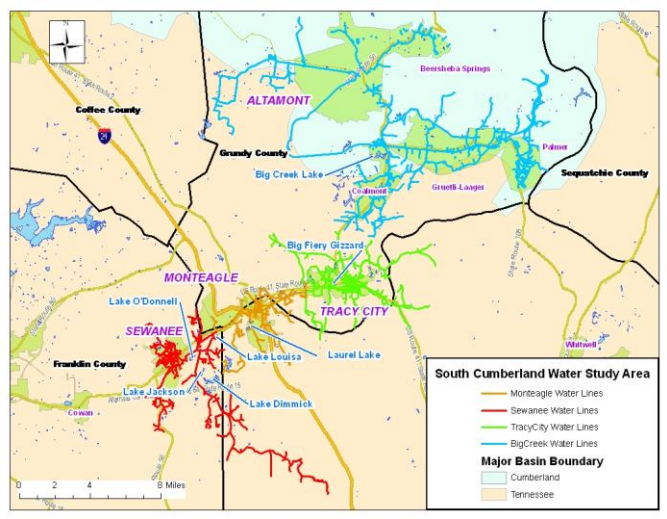
Presentation Outline

- Phase I Overview
- Phase II Tasks
- Phase II Progress
- Additional Activities
- Questions and Comments

Phase I Overview

- Collection and documentation of existing water source information, use, and demand for study area
- Collection and documentation of existing water distribution system and wastewater discharge information
- Development of GIS Database





Phase II Tasks

- Regional Drought Evaluation
- Existing Water Source Yield Analyses
- Water Quality and Source Contamination Threat Evaluation
- Water Demand Management Strategies
- Alternative Water Source Identification
- Alternative Water Source Yield Analyses

Phase II Progress

- Regional Drought Evaluations
  - Utilize Standardized Precipitation Index – reflects occurrence probability of rainfall totals for selected durations
  - Practical limits of -4 to 4 (standard deviations away from mean)
  - SPI computed at multiple drought durations: 1 month to 60 months
  - Period of Record : 1928-2009

SPI Values	
2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

Phase II Progress

Regional Drought Evaluations

- North Central Area:
  - Early 1930's, early 1940's, mid 1950's droughts are dominant droughts at all durations
  - 1930's and 1950's droughts are likely critical for study area - intensity at short duration
- Southern Cumberland Area
  - Early 1930's and 2007-2009 droughts are dominant droughts for 6-36 month duration
- Critical drought duration varies according to reservoir size and shape, demand, and watershed characteristics

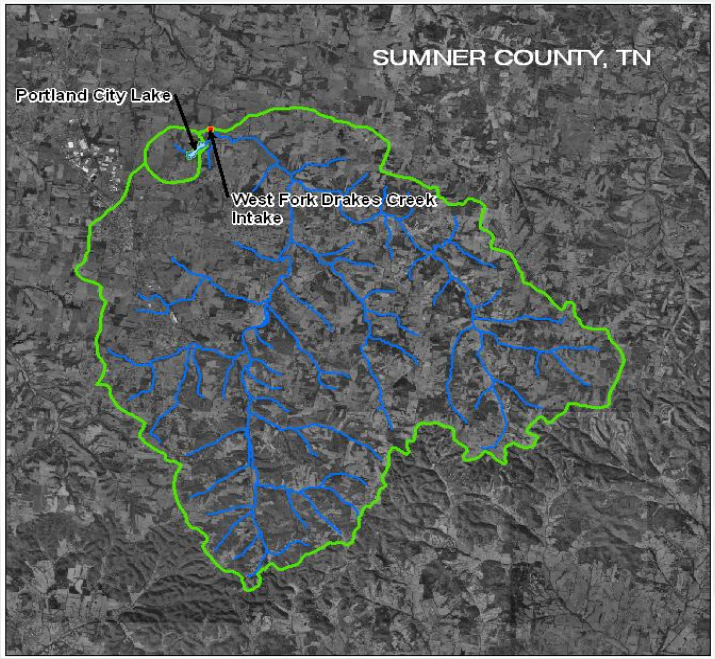
Phase II Progress

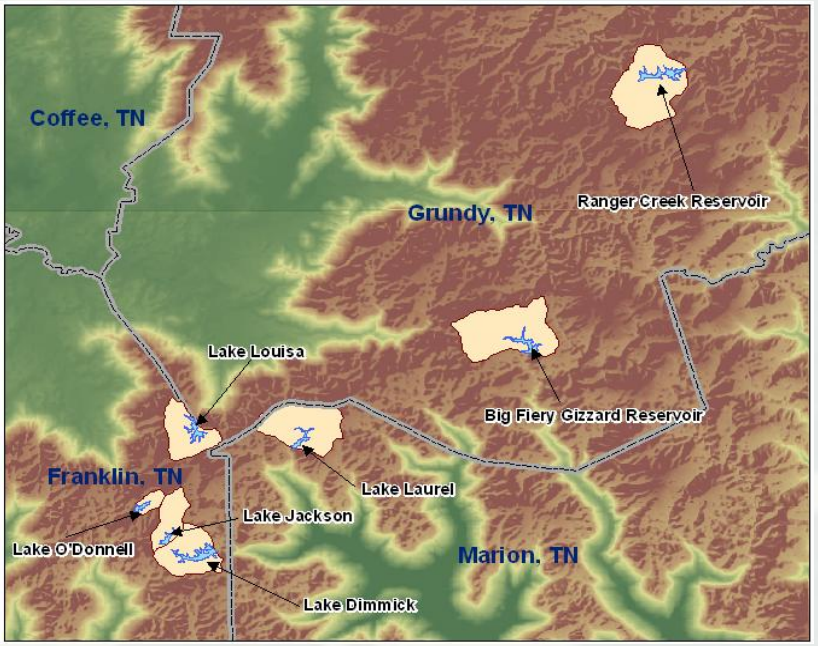
Existing Water Source Yield Analyses

- North Central Area –
  - ► Primary Source of Water for Region is Old Hickory Lake
    - Exception is Portland Which Principally Relies Upon West Fork Drakes Creek and Portland City Lake
- South Cumberland Area –
  - ► Multiple Small Reservoirs Provide Source Water
    - Sewanee – Lakes O'Donnell, Jackson, Dimmick
    - Monteagle – Lakes Laurel, Louisa
    - Tracy City – Big Fiery Gizzard Lake
    - Big Creek UD – Ranger Lake

Phase II Progress

Existing Water Source Yield Analyses





Phase II Progress

Existing Water Source Yield Analyses

- Hydrologic models (HEC-HMS) of watersheds generated inflow sequences to reservoirs
- Sequent peak algorithm used to analyze inflow sequence, identify critical drought, and compute firm yield

$$K_t = (D_t - Q_t) + K_{t-1}$$

Where:

K_t = cumulative deficit at time (t)

D_t = demand (yield) at time (t)

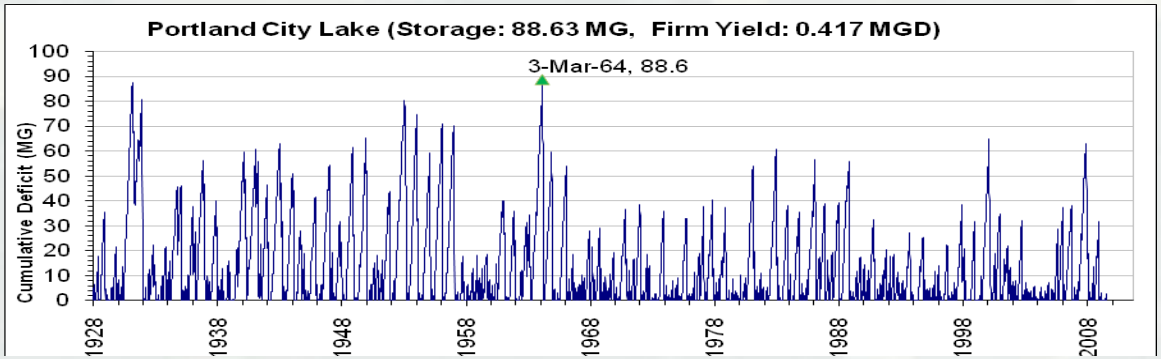
Q_t = inflow at time (t)

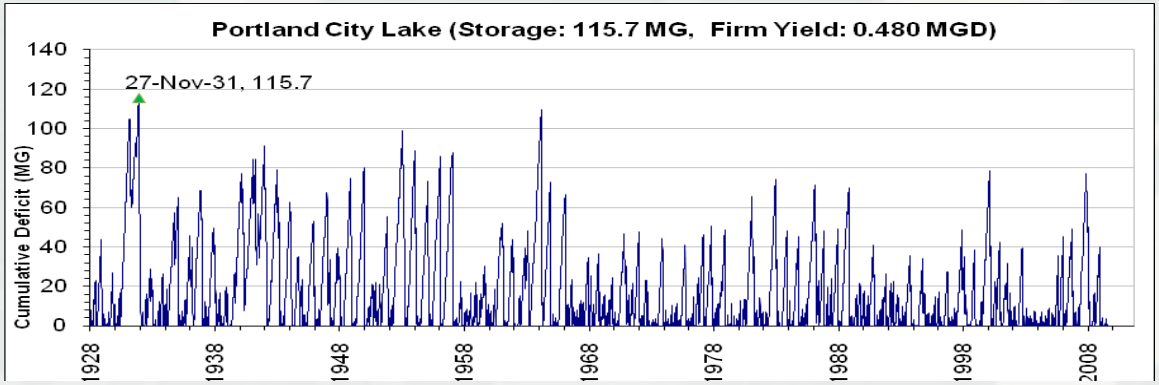
K_{t-1} = cumulative deficit at time (t-1)

- Firm yield is calculated by solving for the yield at which cumulative deficit is exactly equal to the reservoir's available storage capacity

Phase II Progress

Existing Water Source Yield Analyses



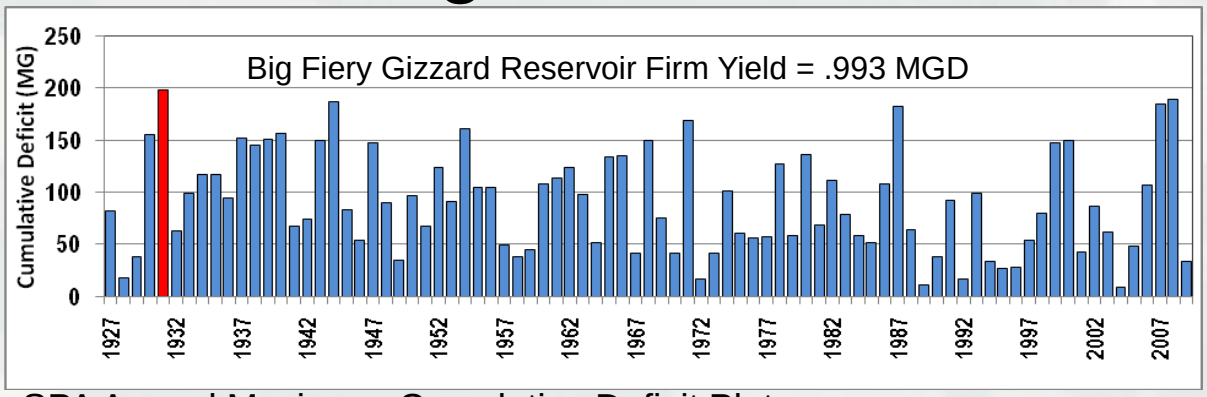


Sequent Peak Algorithm (SPA) Cumulative Deficit Plots at a Daily Time-step

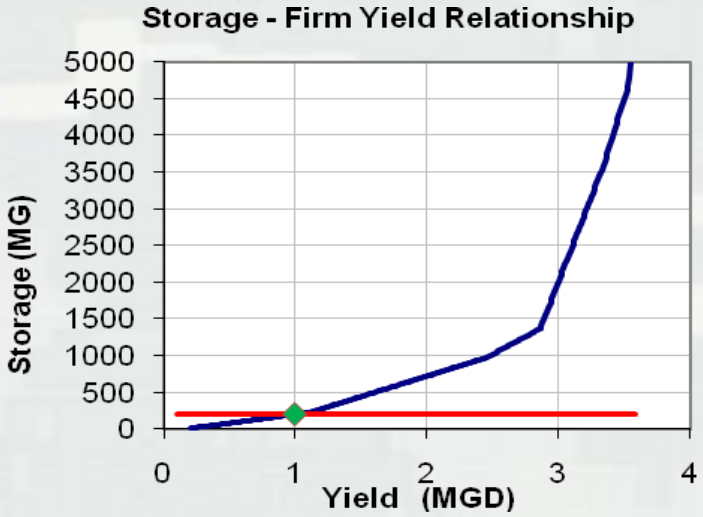
Firm Yield Computations are Dependent Upon Accurate Estimates of Available Storage in the Reservoir

Phase II Progress

Existing Water Source Yield Analyses



SPA Annual Maximum Cumulative Deficit Plot

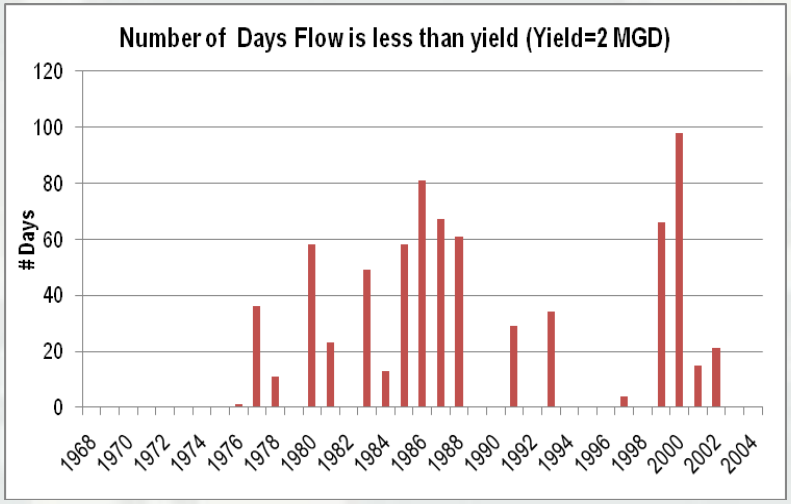


By varying the theoretical amount of storage available, and calculating the corresponding firm yield, a storage-firm yield relationship for the watershed can be determined.

Phase II Progress

Existing Water Source Yield Analyses

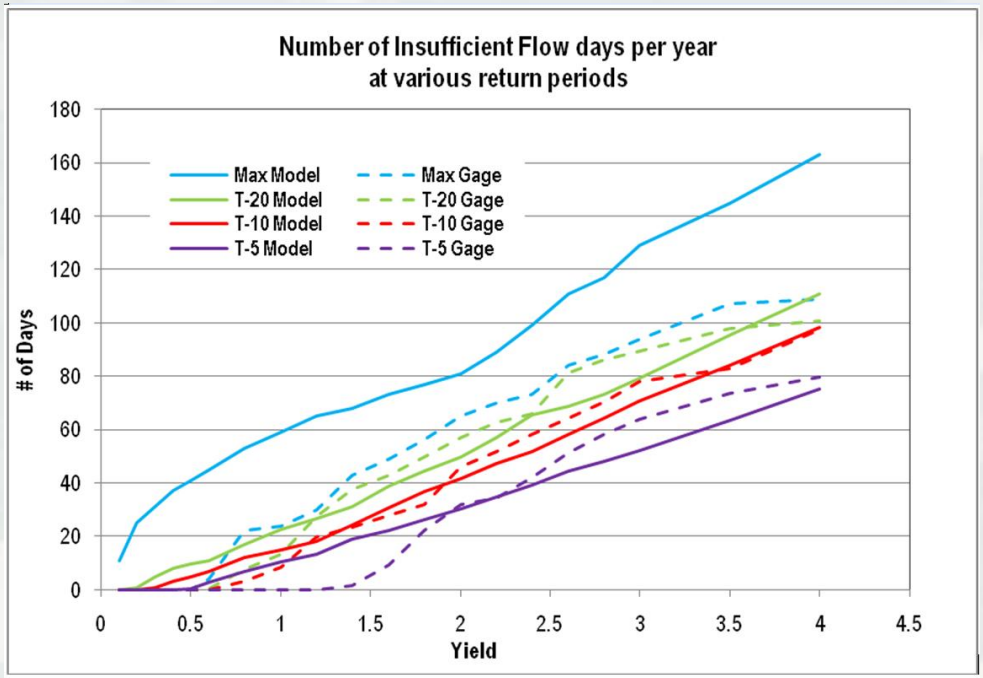
- West Fork Drakes Creek
  - Construct period of record reference flows (36 years)
    - D.A. adjustment from USGS gage downstream
    - Replace net withdrawals
  - Calibrated basin model to period of record reference flows – simulated full precipitation record (81 years)
  - Examine for a withdrawal rate (yield), the ability of the stream to meet demand



Phase II Progress

Existing Water Source Yield Analyses

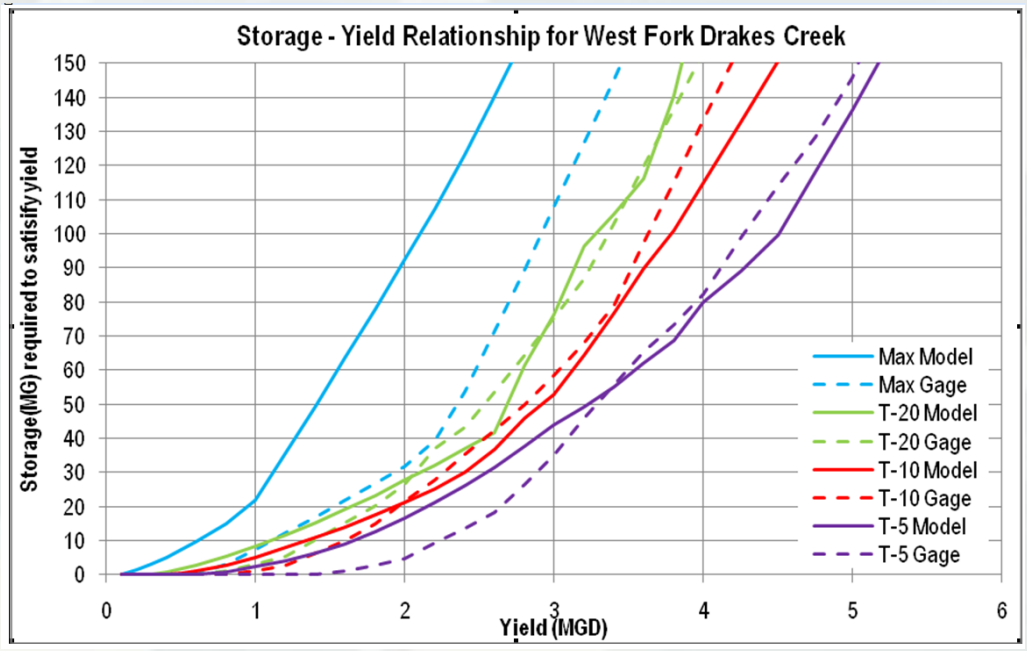
- Estimate non-exceedance probability at various return periods – Weibull or Graphical Method
- Probability reflects chance that number of days flow is less than yield will be equal to or less than certain value
- Inverse of probability is return period (T)
- T-5, T-10, and T-20 mean there is a 20%, 10%, or 5% chance of occurrence in any given year



Phase II Progress

Existing Water Source Yield Analyses

- Sequent Peak Algorithm used to develop “storage/yield” relationship
- Plot represents amount of storage required to withdraw yield at given reliability
- Current Portland average demand is 2 MGD
- ~90 MG storage required in addition to river flows to yield 2 MGD without fail



Phase II Progress

- Water Quality and Source Contamination Threat Evaluations:
  - Survey of EPA Regulated Sites Within Watersheds
  - Identification of Other Potential Threats to Source Water
    - Land Use
    - Development
    - Commercial Activities
  - Review and Summary of National Tap Water Quality Database Results of Finished Water Quality for all Utilities

Phase II Progress

Water Demand Management Strategies

- Existing Practices and Plans Reviewed
- Evaluation of Active and Passive Measures Planned
  - Reduce Unaccounted for Water Loss
    - Metering Improvement, Line Flushing Reduction
    - Leak Detection and Repair
  - Conservation Pricing
  - New Construction Standards
  - Retrofit, Replacement, Rebate Programs
  - Education

Phase II Progress

Alternative Water Source Identification

- Existing Source Improvement – Both Study Areas
  - Optimize Water Sharing between Utilities – Existing or Improved Interconnections
- New Source Development
  - North Central
    - Portland's Caney Fork Creek Project
    - Additional Withdrawals from Old Hickory Lake
  - South Cumberland
    - New Reservoir on Big Creek
    - Purchase of Ramsey Lake
    - Raise Big Fiery Gizzard Lake
    - South Pittsburgh Pipeline to Watts Bar Lake

Additional Activities

- Developing Scope of Work for Contractor
  - Phase II Study Activities
    - Support Energy Audits of White House and Big Creek UDs
    - Support Evaluating Financial Strength of Utility Systems
    - Conduct Utility Interconnection Capacity Evaluation
    - Support OASIS Model Development and Calibration
  - Phase III Study Activities
    - Preliminary Design of Alternative Water Sources
    - Cost Estimates
    - Alternative Screening Protocol and Decision Matrix

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